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NEURAL PROSTHESIS PROGRAM

Quarterly Progress to:	National Institutes of Health
Contract Monitor:	William Heetderks, Ph.D.
Research Contract:	Surface Modification for Biocompatibility
Contract Number	NS 5-2322
Principal Investigators:	David C. Martin and K. Sue O'Shea
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PROGRESS REPORT

The Martin Laboratory:

Several lines of research are ongoing, as well as the preparation of several publications; three from Chris Buchko's work; one from Mike Johnson's work and an additional publication is now in press:

Shankarram, A. Athreya and Martin, David C.
"Impedence spectroscopy of protein polymer modified silicon micromachined probes"
Sensors and Actuators, 1998, in press.

SLPL Purification

Mike Johnson worked earlier this year in San Diego at Protein Polymer Technologies, Inc. to produce additional SLPL. Repurification of SLPL 3.0 batch 8 is now complete and microchemical analysis indicated it to be 87% pure. This is an acceptable level for cell culture at Protein Polymer Technologies, Inc. Previous impurities believed to be ammonium sulfate salts were removed as evidenced by the limiting level of nitrogen and less than 2% sulfur. The final yield of the repurified material is approximately 1.2g.

Electrospinning Studies

Multiple variables are to be compared through a series of experiments relating fiber diameter to solution viscosity, pendant droplet radius, and overvoltage (voltage above critical). Different spinneret (needle) diameters are being used to create diameter changes in the pendant drop as well as accommodating higher viscosity solutions. Previous theoretical work relating fiber diameter to voltage above critical will be compared.

The experiments are being run with a 1 cm gap at three fixed voltages, 4000, 4500, and 5000 V, all above the critical spinning voltage of approximately 3000 V. The four solution viscosities are 0.5, 1, 5, and 10 Pa s. Needle sizes are 0.15, 0.33, and 0.58 mm diameter to accommodate the large range of viscosities, as well as to produce different droplet radii. Analysis of the deposited fibers under a scanning electron microscope will provide fiber dimension statistics for correlation with the above parameters.

This study is expected to further the understanding of not only this system, but to give insight into the electrospinning parameters, including the relative importance of each parameter and the limits of the process in terms of solution concentration and fiber diameter control. Quantification of the variations in the electrospinning process will allow us to control the deposition porosity, and establish a baseline to compare with modulated-field fiber deposition. Mike Johnson is carrying out the work.

O'Shea Laboratory

Work continues in preparing cell and process morphology, cell migration data on the various substrates for publication. Data have been acquired; analysis of distances migrated is currently in progress. We are also working to obtain reflection interference microscopy analysis of cells on the various polymer substrates, to give an indication of the nature of the cell - substrate interaction. In addition, we believe that it will be important to carry out time-lapse video analysis of cell behavior as well, since with increasing time in culture, cells may produce their own adhesive substrates. These studies will be carried out in collaboration with others in the Department of Anatomy and Cell Biology, as we do not have time-lapse capabilities on our inverted microscope.

The Department of Anatomy and Cell Biology has just acquired a new 1000B Scanning Electron Microscope that we will also use later in the summer to examine neuron - substrate interactions.

Plans

David Martin will return to Ann Arbor in September, and we will begin to plan new approaches to biopatterning and new ways of promoting interactions of electrical devices with neurons, based on collaborations he has made during his sabbatical in Germany.

The Kresge group is continuing to improve visualization methods for examining cell - biopolymer coated probe interactions, and hopefully in the very near future will finish sectionining previously embedded coated probes placed into Guinea pig cortex, so that this analysis can be completed.

The O'Shea group will continue working to analyze cell behavior data, and particularly to produce representative micrographs of cell morphology on the various patterned substrates for publication.